PL 1051

Relinquishment Report

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1 License history

Licence Details

PL 1051 lies in blocks 35/12, 36/10, 31/3, 32/1. It was applied for during APA 2019 and awarded on the 14th of February 2020. Fig. 1.1

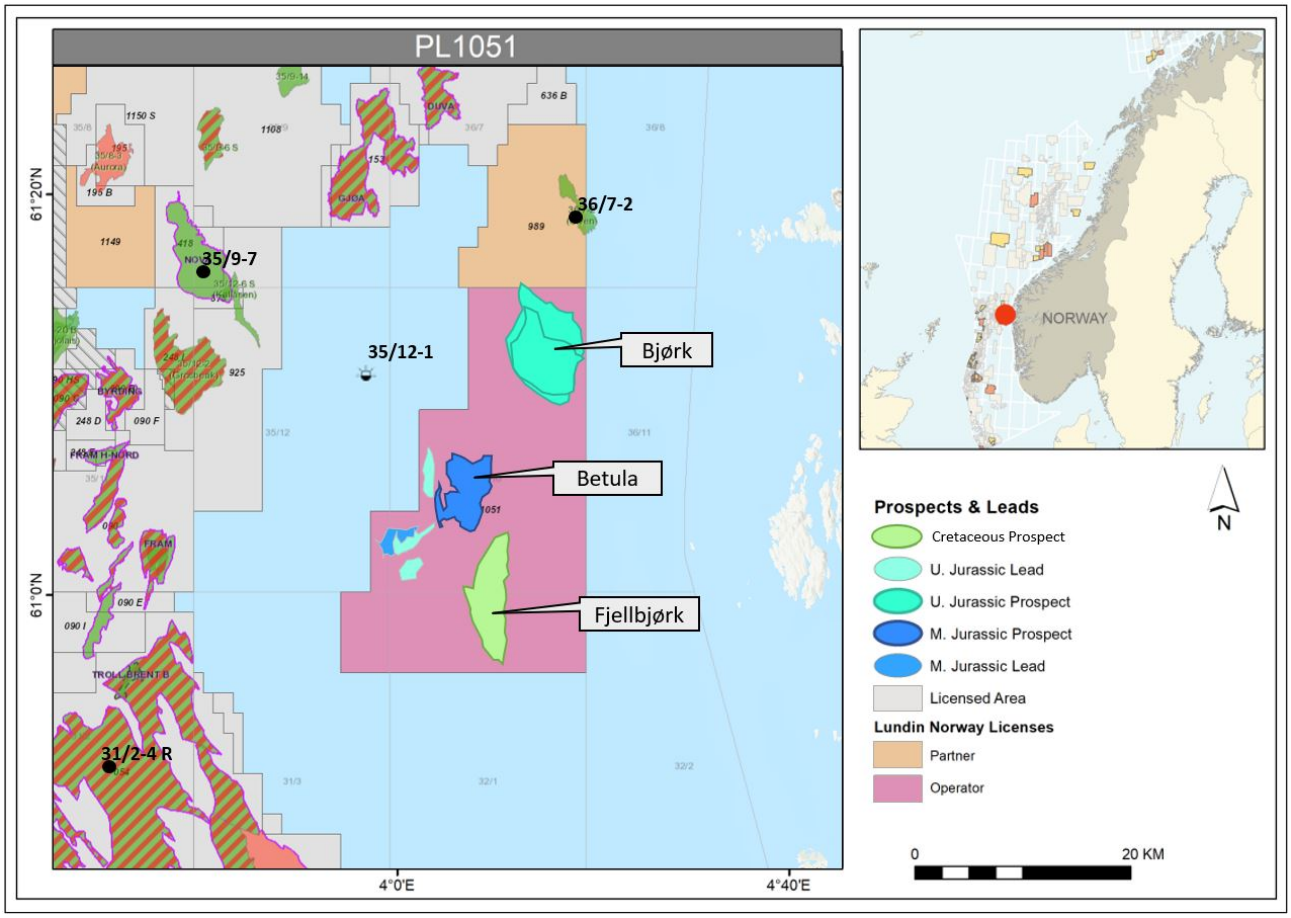

Fig. 1.1 License Details

The license partnership has remained unchanged and consists of:

- Aker BP ASA as Operator (60%)
- Neptune Energy AS (20%)
- Petoro AS (20%)

License Meetings

The following meetings were held in the license:

2020

- Exploration / Management Committee Meeting 04.04.2020. Start-up meeting.
- Exploration / Management Committee Meeting 18.11.2020. Year-end meeting.

2021

- Exploration / Management Committee Meeting 29.11.2021. Summary of re-processing.
- Exploration Committee Work Meeting 28.05.2021. Present re-processing results.

2022

- Exploration / Management Committee Meeting 08.04.2022. License extension discussion.
- Exploration Committee Work Meeting 28.01.2022. Show Fjellbjørk AVO response.
- Exploration / Management Committee Meeting 14.10.2022. Presentation of CSEM results.
- Exploration / Management Committee Meeting 12.12.2022. Formally propose relinquishment

Work Programme

The work commitments for the license were to acquire and reprocess 3D seismic, conduct an EM feasibility study, conduct geological/geophysical studies, and DoD within 2 years. These have all been fulfilled.

On the 4th of January 2022, the partnership applied for a license extension of one year. This was granted on the 9th of March 2022.

Relinquishment

Three prospects were identified and evaluated in this license: Bjørk, Betula, and Fjellbjørk in the respective order. The reason for relinquishment is all the abovementioned prospects being dropped due to too high risk.

2 Database

2.1 Seismic data

The common database is shown in and in Fig. 2.1.

Table 2.1 Seismic Database with NPDID

Survey	NPDID	Market Available
CGG18M01		Yes
Underlying surveys: CGG14003	7984	Yes
CGG14006	8128	Yes
CGG15001	8179	Yes
CGG15003	8194	Yes
CGG15004	8195	Yes
CGG15005	8196	Yes
CGG15007	8252	Yes
CGG16001	8332	Yes

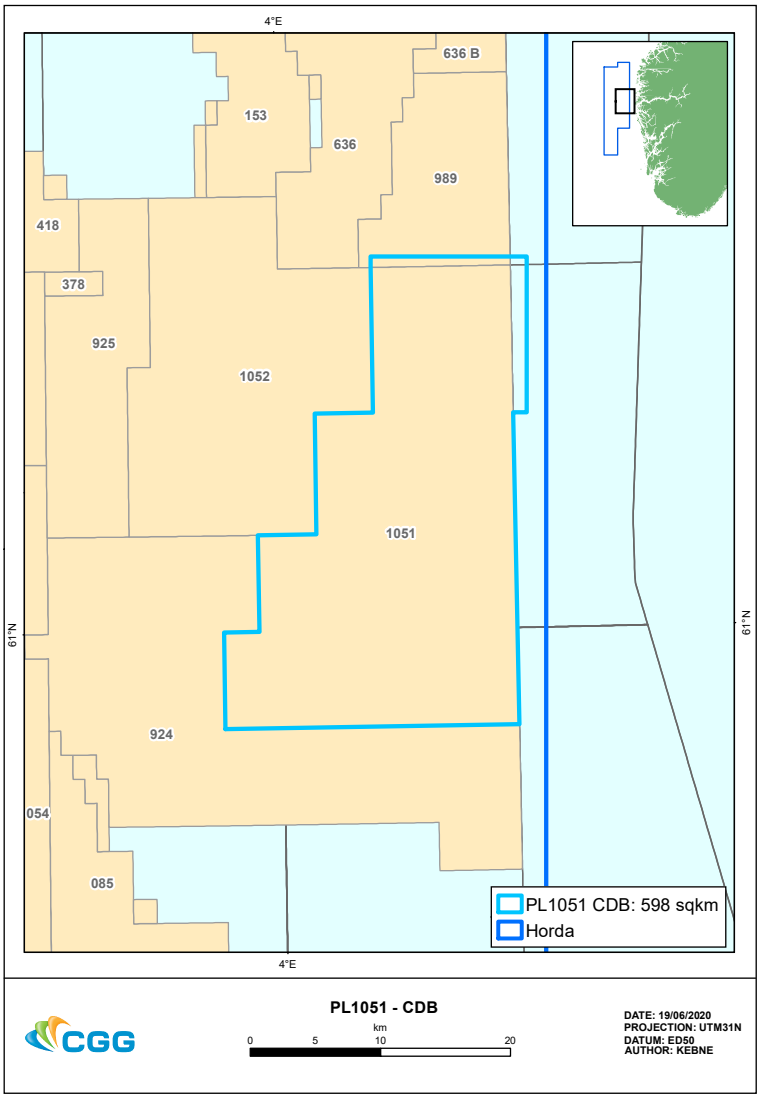

Fig. 2.1 Common Seismic Database

The CGG18M01 survey contained extensive residual multiples, diffracted multiples, and a velocity anomaly in the overburden. Therefore, reprocessing was carried out. CCG21M03LUNR21 is the reprocessed seismic cube. The main objectives for re-processing were improving the imaging quality of the defined main targets by 1. More advanced / efficient pre- and post-processing which includes but not limits to: denoise, deghosting, demultiple, spectral enhancement and 2. The updated velocities models.

The reprocessing gave significant uplift with much cleaner, sharper and spatially coherent imaging compared with the legacy products. It greatly improved noise / multiples removal and much better velocities. Fault imaging was greatly improved, and multiples are much better attenuated than legacy, primary amplitudes are better preserved.

2.2 Well Data

The wells have been used for seismic tie, correlation, reservoir property evaluation, fault seal analysis, AVO and rock physics study, and Joint Operator Migration Study (JOMS).The common well database with corresponding NPDIDs is listed in .

Table 2.2 Common well database with NPDID

Wellbore	Name	NPDID Wellbore	NPDID Discovery	NPDID Field
31/6-6		127	44552	46437
31/3-3		447		
32/2-1		5839		
32/4-1		2918		
32/4-3 S		8900		
35/9-1	Gjøa	1375	44786	4467574
35/9-2	Gjøa	1600	2449421	4467574
35/9-3	Hamlet	3206	45651	
35/9-14		8358	31164621	
35/9-14 A		8397	31164621	
35/12-1		1881		
35/12-5 S		7683		
36/7-1	Gjøa	1794	44792	4467574
36/7-2	Ulven	2990	44798	287902
36/7-3		4427		
36/7-4	Duva	7988	28543124	34833026

3 Geological and geophysical studies

Petroleum system analysis

The Bjørk prospect was expected to be charged via long distance migration or by remigration from potential paleo-accumulations. Migration was considered relatively high risk for Betula due a depth-sensitive migration route at Brent level. Several of the accumulations on the eastern margin of the Viking Graben have been biodegraded and the nearest discovery to the prospects is heavily biodegraded (36/7-2). Shallow accumulations charged at an early stage, such as Fjellbjørk, have a high risk of suffering from biodegradation.

Joint Operator Migration Study (JOMS)

Migration study of quadrant 35 with the other operators on the quadrant: DNO, Neptune, Wellesley, Wintershall DEA, and Equinor. The results of JOMS gave a much better understanding of migration, petroleum populations, and charge in the 35th quadrant.

Fault seal analysis

V-shale logs from key well 36/7-2 were used to extrapolate lithologies towards the fault that seals Betula in the east. This was a relatively high-risk area of the trap due to it being a relay ramp. Two fault sealing models were used and the study concluded that the relay ramp would be able to hold a hydrocarbon column of maximum 119 m, which was not sufficient even for the Betula P90 case.

AVO and rock physics

AVO and fluid substitution suggested the soft Bjørk amplitude anomaly was due to the presence of coal. This was strengthened by frequency blending and literature.

AVO and fluid substitution work on Fjellbjørk showed a possible class III AVO anomaly. However, the lack of lithology and age control due to the far distance to nearby wells weakened our understanding of this result. This ambiguity led to the decision to carry out CSEM, which was the remaining study that could potentially de-risk Fjellbjørk.

Imaging By InversionS (IBIS) processing

The objective of the in-house IBIS processing was to obtain a reliable full elastic solution and to assess the AVO-confidence in legacy seismic. It was done from raw shots to final migrated image / angle gathers through consecutive inversions (equivalent to designature, deghosting, demultiple, regularization). The results gave a significant uplift in imaging over Fjellbjørk.

CSEM survey over Fjellbjørk prospect

A feasibility study in 2020 showed that CSEM was suitable to de-risk and characterize Fjellbjørk. To de-risk the Fjellbjørk prospect, the license group utilized the CSEM survey NS2202, acquired and processed by EMGS.

4 Prospect update

The primary prospect at the time of the license acquisition was the Upper Jurassic Bjørk prospect. It was dropped due to the risk of coal presence. Betula then became the main prospect and was up for well candidacy. Re-processing led to a drop decision on Betula, and Fjellbjørk was the remaining prospect. [redacted] results led to Fjellbjørk also being dropped.

The PL1051 license is located on the northern part of the Horda Platform to the west of the Øygarden Fault Complex (ØFC) and covers the eastern part of the Uer Terrace.

Bjørk

Bjørk is an Intra Heather prospect located south of the J2 discovery and directly west of the ØFC. It is mapped on a strong amplitude anomaly that was initially believed to have been a hydrocarbon indicator. It is bound by faults in the north and south, and dip in the west and east.

Betula

Betula prospect is situated east of the Uer Terrace (Fig. 4.1). It is a three-way dip closure with a sealing fault zone in the north. After the enhanced imaging from re-processing, the fault zone showed to be a relay ramp, which increased the trap risk significantly. The reprocessing and new velocity model also reduced the size of the structure, resulting in uncommercial volumes. (Fig. 4.2).

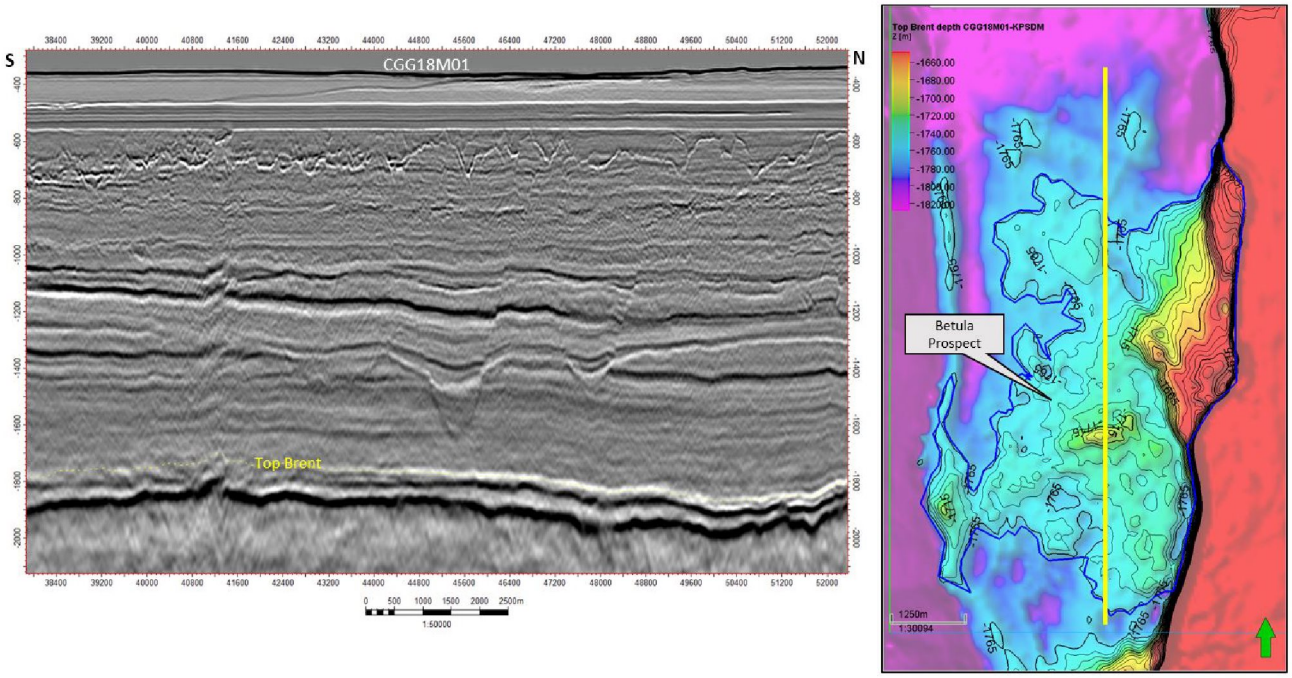

Fig. 4.1 Betula Prospect

Table 4: Discovery and Prospect data (Enclose map)

Block	36/10	Prospect name	Betula	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	
Play name	NPD will insert value	New Play (Y/N)		Outside play (Y/N)					
Oil, Gas or O&G case:	Oil	Reported by company	Lundin Norway	Reference document				Assessment year	2019
This is case no.:	1 of 1	Structural element	Uer Terrace	Type of trap	Structural	Water depth [m MSL] (>0)	340	Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE		**Main phase**				**Associated phase**			
Volumes, this case		Low (P90)	Base, Mode	Base, Mean	High (P10)	Low (P90)	Base, Mode	Base, Mean	High (P10)
In place resources	Oil [10^6 Sm^3] (>0.00)	10,00	21,00	22,00	36,00				
	Gas [10^9 Sm^3] (>0.00)								
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	4,00	8,00	9,00	17,00				
	Gas [10^9 Sm^3] (>0.00)								
Reservoir Chrono (from)	Bathonian	Reservoir litho (from)	Brent Gp	Source Rock, chrono primary	Kimmeridgian-Volg	Source Rock, litho primary	Draupne Fm	Seal, Chrono	Callovian
Reservoir Chrono (to)	Toarcian	Reservoir litho (to)	Statfjord Gp	Source Rock, chrono secondary	Callov-Oxfordian	Source Rock, litho secondary	Heather Fm	Seal, Litho	Heather Fm shales
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,12	Oil case (0.00-1.00)	1,00	Gas case (0.00-1.00)	0,00	Oil & Gas case (0.00-1.00)	0,00		
Reservoir (P1) (0.00-1.00)	0,80	Trap (P2) (0.00-1.00)	0,50	Charge (P3) (0.00-1.00)	0,30	Retention (P4) (0.00-1.00)	1,00		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)	1765	1780	1785						
Area of closure [km^2] (> 0.0)		21,0							
Reservoir thickness [m] (> 0)	40	60	80						
HC column in prospect [m] (> 0)	220	247	250						
Gross rock vol. [10^9 m^3] (> 0.000)	0,200	0,450	0,650						
Net / Gross [fraction] (0.00-1.00)	0,40	0,50	0,60						
Porosity [fraction] (0.00-1.00)	0,16	0,19	0,22						
Permeability [mD] (> 0.0)	10,0	50,0	1000,0						
Water Saturation [fraction] (0.00-1.00)	0,40	0,30	0,25						
Bg [Rm3/Sm3] (< 1.0000)									
1/Bo [Sm3/Rm3] (< 1.00)	0,71	0,75	0,79						
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)	60	130	180						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,30	0,40	0,50						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,30	0,40	0,50						
Recov. factor, gas main phase [fraction] (0.00-1.00)									
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)				Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
Pressure, top res [bar] (>0)				Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
Cut off criteria for N/G calculation	VCL<0,5	PHIE>0,1	3.					Kart nr	NPD will insert value

Fig. 4.2 Revised Prospect Data

Fjellbjørk

Fjellbjørk prospect is an Upper Cretaceous/Lower Paleocene prospect mapped on an isochore thickening and an amplitude anomaly (Fig. 4.3). It is believed to be a slope fan system sourced from the sandy Upper Jurassic hinterland directly south of the license. Due to the lack of chronostratigraphic control, CSEM data was used to de-risk Fjellbjørk, [redacted]

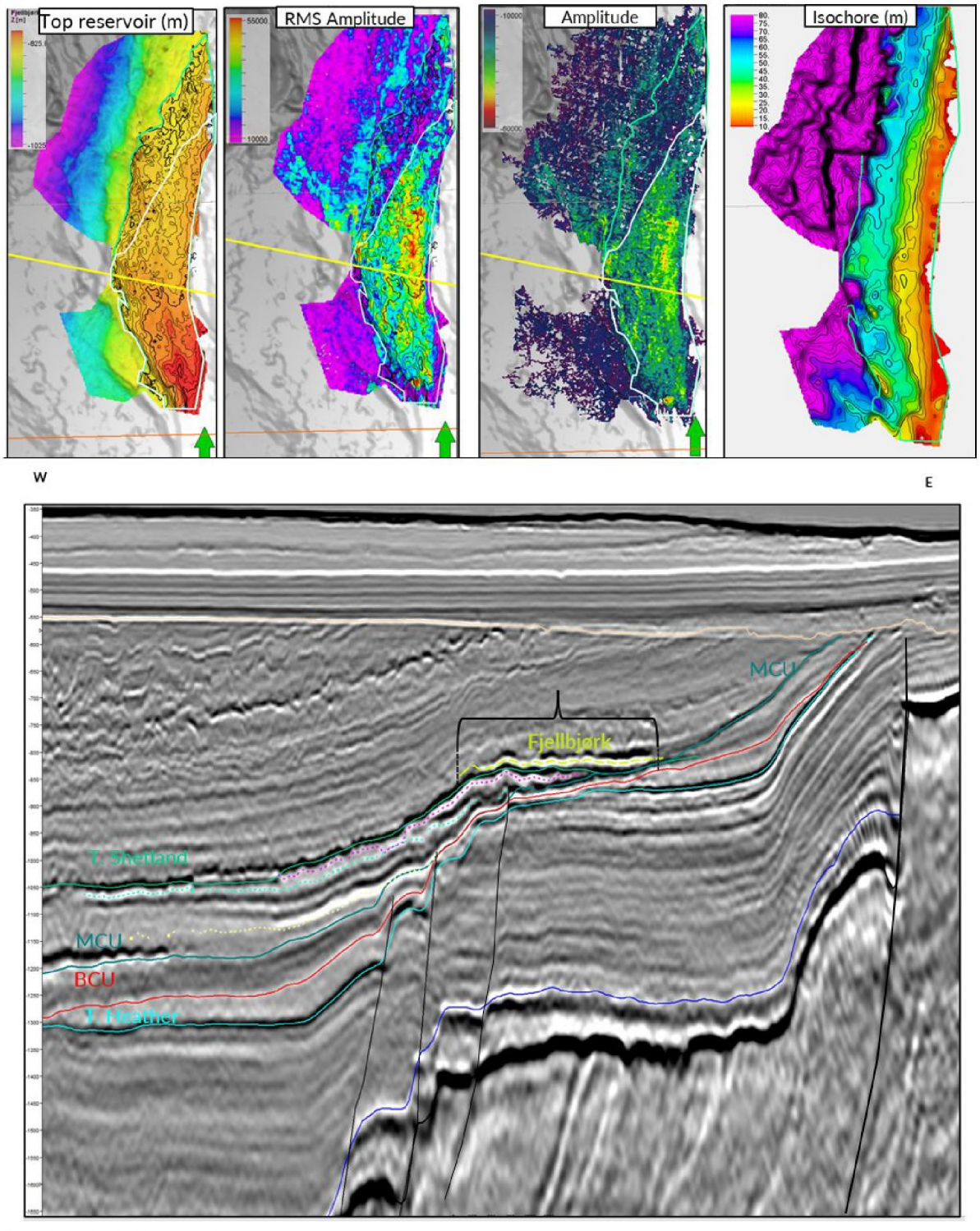

Fig. 4.3 Fjellbjørk Prospect

Resources

Shows the resource potential of Bjørk, Betula, and Fjellbjørk prospects.

Table 4.1 Resource potential for PL 1051

Discovery / Prospect/ Lead name[1]	D/ P/ L[2]	Case (Oil/ Gas/ Oil&Gas)[3]	Unrisked recoverable resources [4]						Probability of discovery [5] (0.00 - 1.0)	Resources in acreage applied for [%] [6] (0.0 - 100.0)	Reservoir		Nearest relevant infrastructure [8]	
			Oil (10^6Sm^3] (>0.00)			Gas (10^9Sm^3] (>0.00)					Litho-/Chrono-stratigraphic level [7]	Reservoir depth [m MSL] (>0)	Name	Km (>0)
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)						
Betula	P	Oil	4.00	9.00	17.00				0.12	100.0	Bathonian	1780	Gjøa	30
Fjellbjørk	P	Oil	2.00	15.75	35.69				0.13	100.0	L Cretaceous	790	Gjøa	40
Bjørk Intra Heather Upper	P	Oil	4.62	14-24	26.45				0.17	100.0	Callovian	1159	Gjøa	25
Bjørk Intra Heather Lower	P	Oil	des.85	38.23	70.20				0.21	100.0	Callovian	1200	Gjøa	25

5 Technical evaluation

Since no prospect remains within the license, a technical evaluation with respect to economical value and possible development solution is not performed.

6 Conclusion

The license commitments are fulfilled. As written in 4 Prospect update section, all prospects in this license have been mature, evaluated, and dropped due to high risk. The partnership therefore wishes to relinquish the license.